A PROJECT REPORT ON

INTEGRATED SOLID WASTE MANAGEMENT

In partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

IN

CIVIL ENGINEERING

Jawaharlal Nehru Technological University Hyderabad

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UNDER THE GUIDANCE OF

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Mount Opera Premises, Near Ramoji Film city, Batasingaram Village, Hayathnagar(M),

Ranga Reddy (Dist.)

2021-2022

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CERTIFICATE

This is to that the report entitled **"INTEGRATED SOLID WASTE MANAGEMENT"** is being submitted by the following of IV-year B. Tech II-Semester of CIVIL ENGINEERING is a record bonafied work carried out by them. The results embodied in the report have not been submitted to any other universities for the award of any degree partial fulfilment of the requirements for the award of **Bachelor of Technology in Civil Engineering** during the academic year 2021-2022.

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DECLARATION

We hereby declare that the work which is being presented in the report entitled "**INTEGRATED SOLID WASTE MANAGEMENT"** submitted towards the partial fulfilment of the requirement for the award of degree of B. TECH in Civil Engineering, ARJUN COLLEGE OF TECHNOLOGY AND SCIENCES, Ranga Reddy is an authentic record of my own work carried out under supervision of Mr. B. J. CHIRANJEEVI (HEAD OF THE CIVIL DEPARTMENT) Arjun College of Technology and Sciences, Ranga Reddy.

To the best of my knowledge and belief, this project is known to resemblance with any report submitted to the Arjun College of Technology and Sciences, Ranga Reddy or any other universities for the award of any degree.

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Acknowledgement

This satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people who made it possible, whose constant guidance and encouragement crowned our efforts with success. it is a pleasure aspect that we have now the opportunity to express our gratitude for all of them.

We would like to thank **Mr. P. PAPARAO**, Secretary of Arjun College of Technology & Sciences for giving the opportunity to the do the project.

We would like to thank **MD. MOHAMMED YOUSUF ALI**, principal of Arjun College of technology and sciences for giving the opportunity to do the project.

We would like to thank **Mr. B. J. CHIRANJEEVI** Head of the Department of Civil Engineering, ARJUN College of Technology and Sciences, his wide knowledge and logical ways of thinking have made a deep impression on us. His Understanding, Encouragement and personal guidance have provided the basic but this report.

We would also like to thank **GM Mr. SRINIVAS of HiMSW** and all other teaching staff, for allowing us to complete the project successfully under their guidance.

We are thankful to our Guide. **Ms. B. KALPANA**, Assistant Professor, Department of Civil Engineering for him esteemed guidance behind this report and helped us a lot in finishing this project successfully.

We would also like to thank our parents who supported us for completing this project. We express our deep sense of gratitude and thanks to the Teaching and Non-Teaching staff at our college who stood with us during the project and help us to make it is successful venture.

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ABSRACT

In few decades, managing solid wastes has been one of the burning problems in front of Hyderabad and local authorities. It is a place with increasing population and generates more waste particularly for food and plastic related items. This is due to scarcity of lands for landfill of the municipal solid waste. Not only scarcity of lands it also pollutes whole the environment by dumping and burning the municipal solid waste in the landfills. Judiciously handling the environmental issues like solid waste management has become necessary for sustainable development of the society. Improper management of Solid waste causes various hazards to inhabitants. Food waste generated in Hyderabad constitutes huge number of recyclables which can be recovered if we follow the proper solid waste management practices. Improper disposal of solid waste in open dumps and landfills creates lot of problems to Public Health and Environment. Especially the food waste improperly dumped will produce methane gas that produces 21 times greater impact on global warming than carbon dioxide. The main aim of the study is to find out the challenges in managing waste generation till recycling stage and also examines feasibility of technical, economic and environmental aspects of the waste management.

Thus, conversion of municipal solid waste to Energy and Resources (electricity production, fertilizers production, leachate treatment and extraction of methane gas) is the best approach to reduce space and environment and public health related problems. This has to be managed by technologies that prevent pollution and protect the environment and at the same time minimize the cost through recovery of energy. Energy recovery in the form of electricity, heat and fuel from the waste using different technologies is possible through a variety of processes, including incineration, gasification, aerobic and anaerobic digestion and treatment of leachate water. This was processed under "**Hyderabad Integrated Municipal Solid Waste Management**'' at Jawahar Nagar Dumping Yard".

The purpose of the study is to assess the current status of solid waste management practices in Hyderabad. Effort has also been taken to explore in depth the solid waste to energy programs currently followed in the Hyderabad.

INTRODUCTION

Over the last few decades rapid growth in urbanization, change in life styles and rise in population has resulted in generation of huge quantity of Municipal Solid Waste (MSW) in Hyderabad. The quantity of MSW generated is much higher than the quantity collected, transported and disposed, leading to pilling up of uncollected waste in streets, public places and drains. Even the collected waste is mostly dumped on the outskirts of towns/cities and has created serious environmental and public health problems. Studies have shown that a high percentage of individuals who live near or on disposal sites are infected by gastrointestinal parasites, worms, and other pathogenic organisms. The insanitary methods adopted for disposal of municipal solid wastes are, therefore, a serious health concern. The poorly maintained landfill sites are causes of surface and groundwater contamination, soil and air pollution in Hyderabad.

In order to overcome all these problems, the **Central Pollution Control Board (CPCB), Telangana State Pollution Control Board (TSPCB) and Greater Hyderabad Municipal Corporation (GHMC)** Officials has started Hyderabad Integrated Municipal Solid Waste Management Project (HIMSWMP) at Jawahar Nagar Dumping Yard. The Jawahar Nagar Dumpsite has two components the capped waste in 130 acres of land and integrated solid waste processing facility constructed from reclaimed land of legacy waste in an area of 200 acres. The capping and integrated solid waste processing plant is operated and maintained by **Ramky Enviro Engineers**. HiMSW Ltd. is the organization chosen to operate & maintain facilities to manage the Municipal Solid waste for the city of Hyderabad.

The GHMC finalized an Integrated Municipal Solid Waste Management Project under Jawaharlal Nehru National Urban Renewal Mission (JNNURM) and decided to implement it under Public Private Partnership (PPP). Following the award of the project the GHMC and HIMSW entered into an agreement on the 21st February 2009.

The first task in implementing the project was to set up the new entity, to be the vehicle to implement and operate the project. To effectively implement and successful operate the project, HIMSW formed a new company in the name of "Hyderabad Integrated MSW Limited (HiMSW Ltd.)". HiMSW Ltd. is presently the entity responsible for the implementation and operations of the entire project.

HiMSW Ltd. currently processes about 6000 tons of garbage a day, brought from every part of the city. HiMSW Ltd. aims to conduct the collection and transport as well as the processing and disposal of the city's municipal waste, serving the city from the collection of the municipal waste from house to house, all the way to its secure processing facility in Jawahar Nagar. As a private operator HiMSW Ltd. will improve the efficiency of the existing systems of collection, segregation, transportation and disposal of municipal solid waste. The plan is to phase in the five zones currently serviced by the GHMC, and provide a more efficient service to the Hyderabadi community.

The growth of Municipal Solid Waste has outpaced the growth of the population due to the increasing urbanization and industrialization, resulting in changes in lifestyles, food habits & living standards. The increase in non-degradable waste is alarming. The production and consumption of non-degradable material has increased tenfold, the vast majority of which finds its way to Dumpsites. Urban Local Bodies face the massive challenge of managing this Solid waste as per the Municipal Solid Wastes (Managing & Handling) Rules of the year 2000. The solution lies in educating our citizens to socially responsible practices that can be passed down through the generations along with safe, efficient waste recycling & disposal.

The scope of work includes the following: Infrastructure Development or Up gradation, Operation, Maintenance, and Management per the operational requirements

1. Collection and Transportation of MSW:
    - Primary & Secondary Collection: To ensure waste collection from waste generators within GHMC Area, including primary and secondary collection, and transportation of waste up to transfer stations.
    - Transportation of MSW: MSW generated in the GHMC area would be brought in at transfer stations and to transportation of waste from the transfer stations to the Integrated MSW processing and disposal facility.
2. Processing, Treatment and Disposal of MSW:
    - Processing & Treatment of MSW: To process MSW as per MSW rules and other applicable regulations and to transport and dispose the residual inert matter at the landfill Site.
    - Recycle and reuse of wastes.
3. Reclamation and alternative use of existing dump sites: at Jawahar Nagar, Fathullaguda, Shamshiguda, and Gandhamguda.
4. Information, Education & Communication (IEC) campaigns with the public and all stakeholders in GHMC Area to inculcate good MSW management practices, including recycling, and segregation.
5. Interfacing with existing organized and unorganized waste-collection and management systems to ensure that there is a smooth and harmonious working of the systems.

Fig.1 View of dumpy yard site at Jawahar Nagar

OBJECTIVES OF SMW

- The primary goal of solid waste management is reducing and eliminating adverse impacts of waste materials on human health and the environment to support economic development and superior quality of life.
- The purpose of waste ACT is to support sustainable development by promoting the rational use of natural resources, and preventing and combating the hazard and harm to health and the environment arising from wastes.
- To reduce the quantity of solid waste disposed of on land by recovery off materials and energy from solid waste.
- To assess the activity involved for the proposed and determining the type, nature and estimated volume of waste to be generated.

NESSESITY OF INTEGRATED SOLID WASTE MANAGEMENT:

- Recover materials you could still recycle like glass, plastic, and metal. Sorting solid waste matter manually can be dangerous and risky. Because of these appliances, people don't need to risk their health anymore since it will now be done automatically.
- Minimizes the space essential for landfills. A waste separation plant lessens the level of garbage that will be disposed to landfills. Because recyclable materials are easily distinguished, people around landfill areas won't be affected by the poisonous fumes emitted by solid waste matter over time. Any additional space may also be used for more useful purposes rather than just dumping garbage on it.
- Protects the surroundings or a community from even unwanted effects caused by excessive garbage. Humans are certainly not really the only ones that can be affected negatively by garbage or landfills, but also the environment. Animals can be poisoned if waste matter is not discarded properly.
- Recycling responsibly. Sorting waste recycling plants allow materials to get recycled in the most beneficial way. One example is recycling metal. By sorting metal properly, this material can nonetheless be used, therefore decreasing the desire to mine more metal. The greater number of a great waste management sorting machine can be used, the better benefits it can give everyone in your neighbourhood.

ADVANTAGES AND DISADVANTAGES OF SOLID WASTE MANAGEMENT:

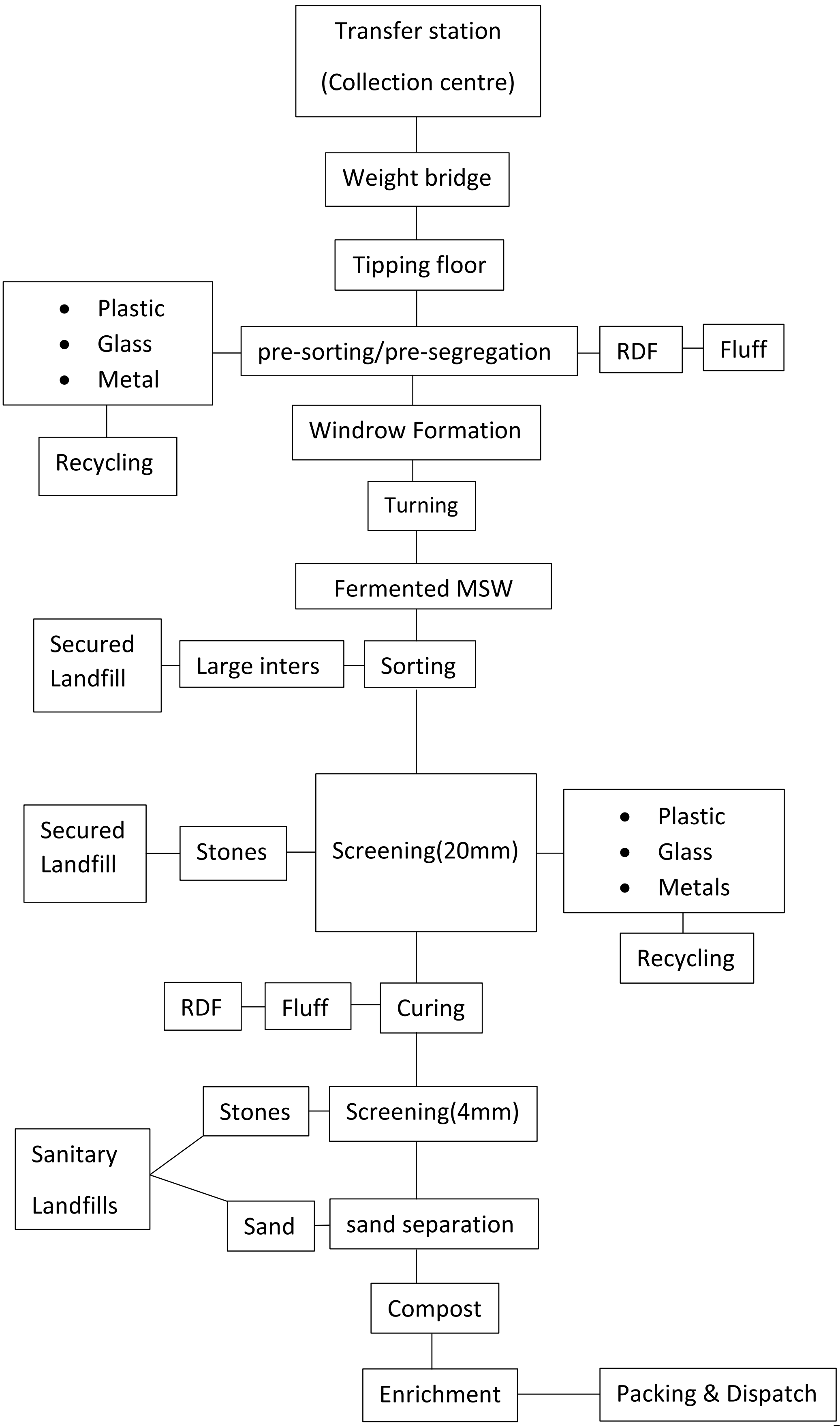
ADVANTAGES:

- Keeps the environment clean and fresh.
- Save the earth and conserves energy.
- Reduces environmental pollution.
- Waste management will help you earn money.
- Creates employment.

DISADVANTAGES:

- The installation of an incineration plant is an expensive process.
- Pollutes the environment.
- Damaging public health.
- Possibility of long-term problems.
- Environmental racism.

FLOW CHART OF INTEGRATED SOLID WASTE MANAGEMENT:



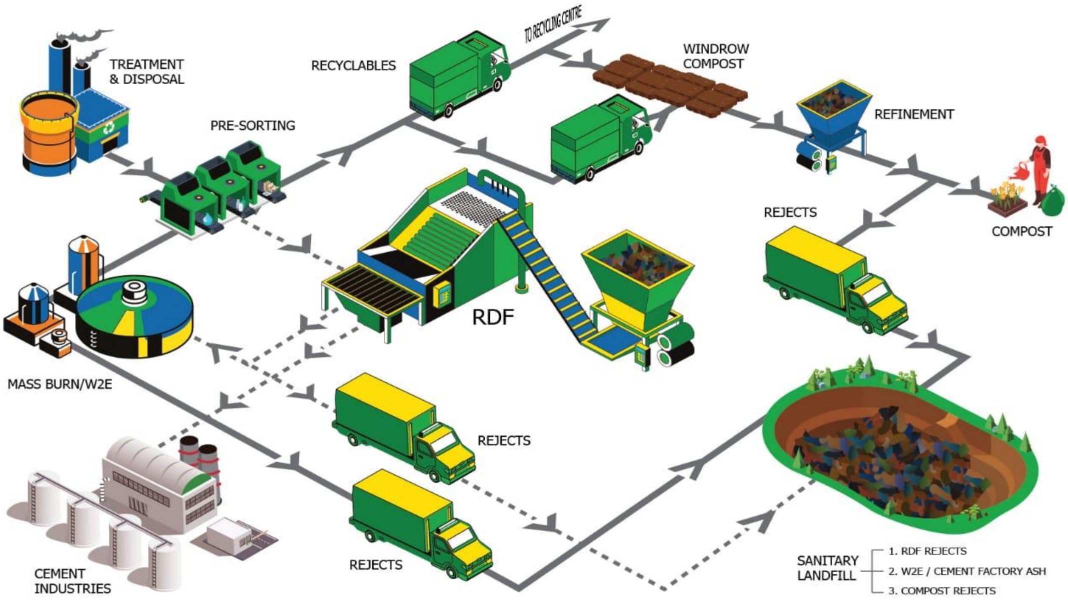


Fig-2 stages of ISWM.

STAGES OF ISWM :

1. Compost
2. Refused derived fuel
3. Waste to energy
4. Leachate treatment
5. Landfill
6. Plastic recycles

BASICS OF SOLID WASTE MANAGEMENT:

Before you go to read about the individual technologies discussed later in this document, it is help to understand some of the basics of solid waste treatment.

You will see items like BOD, COD, DO, SUSPENDED SOLIDS AND DENITRIFICATION frequently when discussing solid waste treatment. Some basic processes of solid waste treatment are also briefly discussed.

If you understand the theory behind the basic treatment process it is easy to see how and why the processes are applied in the various alternative technologies discussed below.

SIGNIFICANCE OF VARIOUS TENTS IN SOLID WASTWE MANAGEMANET

1. Physical analysis

- Colour of leachate
- Temperature
- odour
- particle size
- bulk density

2. chemical analysis

- pH
- BOD (Biochemical Oxygen Demand)
- COD (Chemical Oxygen Demand)
- DO (Dissolved Oxygen)
- Moisture content
- Total Organic Compound
- C/N ratio

City compost FCO Specifications
Schedule- IV (See Clause2 (h) and (q) Part-A
(As amended up to February 2019)

S.No	Parameters	Units	Standards
1.	Colour	-	Omitted
2.	Odour	-	Omitted
3.	Particle Size	-	Minimum 90% material should pass 4.0mm size
4.	pH /25°C	-	6.5-7.5
5.	EC/25°C	Dsm^{-1}	4.0
6.	Bulk density	Gm/cc	<1.0
7.	Moisture content	%	Maximum 25
8.	Total Organic Carbon	%	Minimum 12.0
9.	Total Nitrogen asN, phosphate as P_2O_5, Total Potash as K2O5	%	Minimum 1.2
10.	C/N Ratio	-	<20
11	Arsenic (as As2O3)	Mg/kg	10.0
12	Cadmium (as Cd)	Mg/kg	5.0
13	Chromium (as Cr)	Mg/kg	50.0
14	Copper (as Cu)	Mg/kg	300.0
15	Mercury (as Hg)	Mg/kg	0.15
16	Nickel (as Ni)	Mg/kg	50.0
17	Lead (as Pb)	Mg/kg	100.0
18	Zinc (as Zn)	Mg/kg	1000.0
19	Pathogens	-	Omitted

TERMINOLOGY:

- **Integrated:** combined one thing with another to form a whole
- **Aerobic reaction:** It is a process by which organisms use oxygen to turn fuel, such as fats and sugars into chemical energy.
- **Fermentation:** it is a metabolic process that produces chemical changes in organic substance through the action of enzymes.
- **Sludge:** Sludge is semi solid slurry that can be produced from a range of industrial process from water treatment, waste water treatment or on-site sanitation systems.
- **Leachate:** A contaminated liquid that is generated from water percolating through a solid waste disposal site, accumulating contaminants, and moving into sub-surface area.
- **Solid waste Landfill:** It is a discrete area of land or excavation that receives house hold waste.
- **Incineration:** The destruction of waste material by burning
- **Reverse osmosis (RO) of leachate:** RO is water purification process that uses a partially permeable membrane to separate ions, unwanted molecules and large particles from water.
- **Windrow Composting:** it is a production of compost by piling organic matter are biodegradable a waste in long rows this method is suited to producing large volumes of compost.
- **Refuse Derived Fuel (RDF):** it is a type fuel used for combusting produced from various types of solid waste.

CHAPTER -1

COMPOST UNIT

COLLECTION OF MUNICIPAL SOLID WASTE:

Collection of solid waste from home to home and community bins by the municipal garbage trucks. on Collecting regular pre informed timings and scheduling by using announcements by vehicle. Not only from homes, Collecting wastes from slaughter houses, fish and meat markets, fruits and vegetables market which are biodegradable in nature, and non-biodegradable waste like plastic is also collected.

The waste which is collected by the open garbage trucks is conveyed to the transfer station which is near to that locality. Not only from that particular area, waste collected from all the surrounding areas which comes under that particular transfer station. Storage facilities shall be created and established by taking into account, quantities of wastes generated in a given area and the population densities. A storage facility will be placed that it is accessible to users. By the end of the day the waste which is stored in a transfer station is weighed and transferred to the processing and disposal site [ISWM] by using portable self-compacters [PSC's] which is having a capacity of 20 cubic meter.

There are 2500 autos were flagged off under Swachh Telangana programme, the daily garbage generation on the city was 3500 tonnes. With improvement in efficient in door-to-door garbage collection, provision of transfer station and dumping yards, the garbage generation has now gone up to 6500 tonnes.

Fig-3 Waste collection vehicles

WEIGH BRIDGE:

Weigh Bridge is mainly used to weigh large vehicles which is loaded with waste. Reliable and accurate weighing helps the industry by giving them the exact figures to maintain their goods inward and goods outward. Weigh bridges is useful to calculate the correct figure of waste which is disposed within 24hours.

Weigh Bridge is a system of several components that work together to provide weigh readings when a truck drives on to the scale. The most important components that uses in a weigh bridge are in order to make the weigh measurement is load cell. A load cell is a transducer which converts force into a measurable electrical output.as the cell is subject to weight the wire in the load cell strain gauge is altered or compressed slightly. The change in the wire results in a reference in the resistance to the current passing through it. The analogue signal from each load cell is sent to junction box.

Fig.-4 weigh bridge at dumpy yard

PRE-SORTING UNIT:

The waste pre-sorting process starts with weighing the incoming garbage trucks before depositing their waste in the tipping storage. This acts as a buffer and enables deliveries 24/7 independent of the pre-sorting plant operating hours. It also ensures continuous waste flow during the pre-sorting operation.

The vehicles directed to displace the waste on a secure platform in specified piles. The waste which is displaced is given as a feeder to the trommels for separation with the help of cranes or bobcats or dozers. A trommels is also known as a rotary screen is a mechanical screening machine used to separate materials, mainly in the minerals and solid-waste processing industries. it consists of a perforated cylindrical drum that is normally elevated at angle at the feed end.

It can also be used to improve the recovery of fuel derived solid waste. This is done by removing inorganic materials such moisture and ash from air classified light fraction segregated from shredded solid waste. In pre-sorting unit, the trommels is arranged with a screening diameter of 100 to 70mm. The material which is retained from the trommels is considered as RDF. The material which is segregated through less than 100mm screen is considered as an organic and inorganic acceptance material is composted using windrow composting method.

Fig.-5 Trommel at Pre-sorting Unit

WINDROW COMPOSTING:

Windrow composting process consists of placing the pre-sorted feed stock in long narrow piles called windrows that are turned on a regular basis for boosting passive aeration. The turning operation mixes the composting materials and enhances passive aeration. Following figure gives an overview of the windrow composting process although the figure presented may vary with the characteristics of the waste, design of the plant, and the rigorousness with which the standard operating process is followed. Compost yield of 10-25% is more common from mixed municipal solid waste.

COMPOST PAD[PLATFORM]: the pre-processed MSW is transferred on to compost pad into windrows. The compost pad is an area where the windrows are stacked. The compost pad must be stable, durable, and impervious. The compost pad shall have a slope of about 1% to drain the excess water [stream water or leachate] from windrows into a leachate collection tank.

The following factors have to be considered in the location and design of the composting pad:

- The base as to provide a barrier to prevent the percolation of leachate and nutrients to the subsoil and groundwater.
- The surface has to facilitate equipment movement even during wet weather conditions.

- The surface area has to accommodate waste for 5weeks, with sufficient room for equipment to manoeuvre and an area to establish a static pile for curing compost.

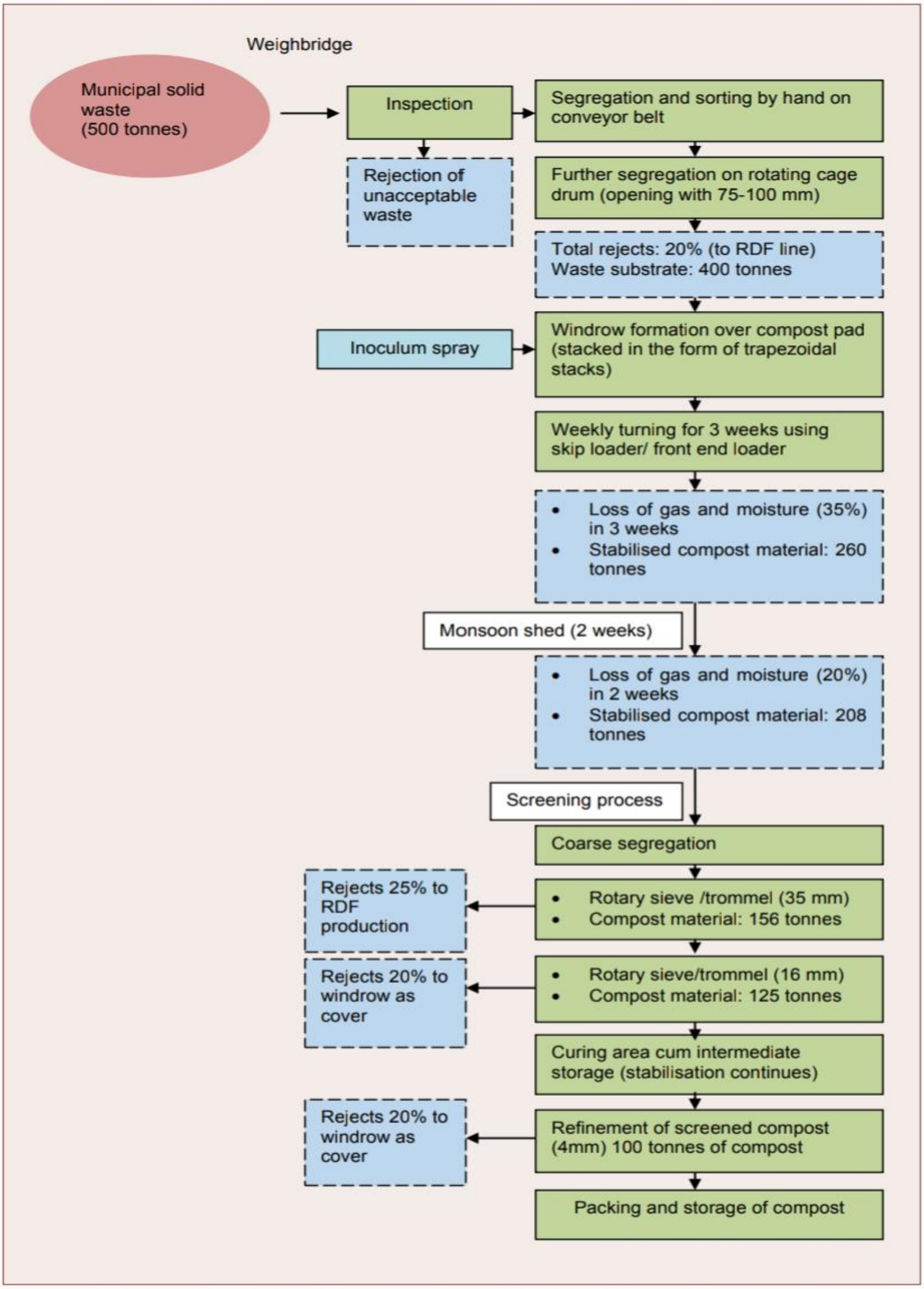


Fig. process flowchart and mass balance for aerobic windrow composting.

The height to base width ratio of the windrow depends basically on the angle of repose of the material. windrows are typically trapezoidal in cross section. The space between windrows should be sufficient for movement of the windrow turning machine. Normally, it is 1-3mts.

A turning schedule should be established based on the rat of decomposition moisture content, porosity of materials. Normally once a week turning is done but more frequent turning is necessary I rainy season (once in 3-4 days). These rows are generally turned to improve porosity and oxygen content, mix in or remove moisture, and redistribute cooler and hotter portion of the pile. Composting process control parameters include the initial ratios of on compost the pile size, moisture content, and turning frequency.

Each windrow should be allowed to stay on the compost pad for 35 days; at the end of the 35th day, the compost is ready for use. Temperature should also monitored and maintained within 55°c. to 60°c. This is important because low or high moisture and variation in temperature can slow down the composting processes. On the 35th day, the compost is successively passed to the monsoon section.

MONSOON SECTION / COARSE SEGREGATION UNIT:

The compost which is taken from the windrow section is passed through the sieve of size 20mm. The material which is passed through the 20mm screen is considered as a semi-finished material and the material which is retained on 20mm screen is considered as a reject. The semi-finished material is now moved to the further process. And the rejects are used in a landfill. This monsoon section is also called as a coarse segregation section.

Screened material coming out of the coarse segregation section requires further maturation and moisture control for producing a product that is beneficial for plants and soils. The degree of maturity is determined through either oxygen uptake or CO_2 production rate. Mature and high-quality compost should have a C/N ratio of around 20. Compost with either higher or lower C/N ratio is not beneficial to the soil.

Fig.-6 MONSOON SECTION/COARSE SEGREGATION

COMPOST REFINEMENT:

At the end of composting phase, the material usually contains 30-35% moisture. The composting is normally taken to be complete when the active decomposition stage is over and the carbon-to-nitrogen (C/N) ratio is around 20.

The refinement section also consists of a feeder conveyer and a trommel with 4mm perforations. The screened product less than 4mm is passed through air density separators (ADS) or de-stoner to remove sand and grit. Then the compost can be put in bags and stored for sale. The remaining material greater than 4mm should be put on top of the fresh incoming waste heap to speed up the process of composting and for absorbing excess leachate. The residue material from the ADS is inert laced with fine organic material. This should be kept out of the composting stream. This material can be used for landscaping.

The finished product is dark brown with an earthy smell, fragile, and rich in organic matter content and nutrients. Value added product can be produced depending on the market demand by enriching composed with beneficial microorganism and nutrient sources such as rock phosphate, pyrite, etc. the product is bagged end and dispatched for marketing to be used on farmer's fields.

Fig.-7 Refinement of compost of 4mm size

After the final product is obtained, the manure is not completely fertile. The sample is taken from the manure to conduct a laboratory test on physical characteristics and chemical composition. After conducting all the tests, the manure is fit for fertilization. And the manure is ready for packing.

PACKING:

The finished compost is collected from the refinement section for packing the bags. Each bag contains the net weight of 50kg's. After packing the bags are keep away from the moisture content area to avoid lumps. These bags are purchased by the different fertilizing companies and fertilizing stores. Some of the farmers are directly purchasing these organic manure bags from the HiMSW to their fields to increase the soil fertility because the obtained manure is purely natural.

Fig.-8 Packing of organic compost

Design and Operational Specifications of Aerobic Composting Process

No	Aspects	Preferable standards and specifications
1	MSW characteristics	Sorted organic fraction of MSW, preferable with the same rate ofdecomposition
2	MSW Particle size	Between 25 – 75 mm for optimum results
3	C/N Ratio	Between 25 – 50 initially. Release of ammonia and impeding of biological activity at lower ratios. Nitrogen as a limiting nutrient at higher ratios
4	Blending & Seeding	Addition of partially decomposed matter (1-5% by weight) reducescomposting time.
5	Moisture content	55% (optimum)
6	Windrow size	3 m length, 2 m width and 1.5 m height (optimum)
7	Mixing/turning	Every four or five days, until the temperature drops from about 66 –60°C to about 38°C or less. Alternate days under typical operating conditions
8	Temperature	50-55°C for first few days and 55-60°C for the reminder compostingperiod. Biological activity reduces significantly at higher temperature (>66°C)
9	Pathogen control	Maintenance of temperature between 60-70°C for 24 hours
10	Air requirement	Air with at least 50% of initial oxygen concentration to reach all partsof composting material
11	pH control	7 – 7.5 (optimum). Not above 8.5 to minimize nitrogen loss in theform of ammonia gas
12	Inoculums	Not desirable, except in special cases
13	Degree of decomposition	Determine by Chemical Oxygen Demand(CED) test or fromRespiratory Quotient (RQ).
14	Area requirement	~25 m^2 for 1 ton of MSW (only for windrow formation for 21 dayscomposting and maturity yard for 30 days stabilization). Area for machinery, packing and storage extra
15	Post treatment care	Facility for effluent (leachate) recycling and treatment and sanitarylandfill of rejects (inert materials, sludge from Effluent Treatment Plant(ETP)
16	Nutrient recovery	2-4 kg N/ton; 1-2 kg P/ton; 1-2 kg K/ton
17	Product recovery	18-25% of waste input
18	Residuals for disposal	2-20% sieving overflow (plastic, metal, glass, stones, uncompostedmatter

CHAPTER -2

REFUSED DERIVED FUEL

(RDF)

REFUSE DERIVED FUEL:

This fuel is produced from combustible components that the industry calls municipal solid waste (MSW). This waste, usually taken from industrial or commercial sites, is shred, dried, baled and then finally burned to produce electricity. Firstly, the waste is sorted in 100mm screen in pre-sorting process. The retained waste which is greater than 100mm is considered as a rejected material. This rejected material consists of combustible and non-combustible materials.

Non-combustible materials used for landfills and the remaining waste material which consists of high calorific value will be used as combustible material.

The RDF is transported to tipping hall and displaced in RDF pit which consists of three types of zones. They are

1. Stacking zone
2. Fermentation zone
3. Feeder zone

STACKING ZONE:

In this zone the displaced RDF will be stored for a period of 4 days. In this period of time the leachate (water) present in the RDF will be drained out and conveyed to leachate pond by drain gallery.

FERMENTATION ZONE:

In this zone the RDF in storage bunker is exposed to atmosphere by help of crane aerobic reaction will be takes place, by this reaction the bad nuisance will be eliminated out. After the aerobic reaction the RDF is stacked

FEEDER ZONE:

In this zone the stacked RDF is given as feeder to the furnace for burning the boilers.

ADVANTAGES OF RDF:

1. RDF is use as bio-fuel in cement manufacturing industries.
2. RDF is used as landfill material.
3. RDF is use fuel in replacement of coal in power plants.
4. RDF contains high calorific value compare to parent materials.
5. The emission characteristics of RDF are superior compared to that of coal with fewer emissions of pollutants like NO_X, SO_X, CO and CO_2

DISADVANTAGES OF RDF:

1. A cost associated with the pre-processing to recover the fuel fraction.

2. Unit yield of energy (i.e., KJ per of MSW) in the case of RDF is less than that of the parent MSW.

Fig.-9 RDF storage pit

CHAPTER -3

WASTE TO ENERGY

INTRODUCTION:

It aims to solve major environment issues namely pollution caused due to plastic waste accumulation and need for an alternate fuel source. The waste to energy process that is used to convert plastic into fuel is pyrolysis.

The conversion of waste matter into various form of fuels that can be used to supply energy is called waste to energy technology. Waste to energy takes non-hazardous waste otherwise destined for landfill, and combusts it. It generating steam for production of electricity. In pre-sorting unit, the rejected waste material which is above 100mm screening is consider as RDF. This waste is carried by lorries or trucks to the tipping hall and dumped. This dumped waste is combustible. Waste to energy is mainly depends on incineration process.

In this tipping hall, incineration process is done to make the waste material more combustible by transferring into boiler. In waste to energy the RDF is contains a material like, plastic, clothes, coconut shells which are combustible to produce steam to energy.

After the total process of incineration, the scrap metals, bottom ash and fly-ash are the by-products. The scrap metals are now almost systematically extracted from the bottom ash. Metal quality is very high and rising market prices mean good income stream for operators.

Reusable bottom ash is a useful construction material and flyash is used for the production of cement in cement industries. Using it offsets the need to extract raw materials, which has considerable environmental impacts. It is disposed of when no demand exists or if waste contaminated it.

In Hyderabad the **Central Pollution Control Board (CPCB), Telangana State Pollution Control Board (TSPCB) and Greater Hyderabad Municipal Corporation (GHMC)** Officials has started Hyderabad Integrated Municipal Solid Waste Management Project (HIMSWMP) at Jawahar Nagar Dumping Yard which has a waste-to-energy plant. This waste to energy plant has the capacity of 20mw generation of power in the Hyderabad.

For the production of 20mw power generation they use 3500 tonnes of 6500 tonnes of garbage waste which is collected in a day in the city.

COLLECTION OF WASTE FOR GENERATION OF POWER :

In collection process for power generation, the waste is carried out by GHMC trucks or lorries which is collected from city in transfer station. The MSW collection & transport project implemented by HiMSW Limited at Hyderabad is most technologically advanced and environmentally sustainable MSW collection and transport system. The project comprises of a fully mechanised secondary collection and transport point located across the city. The waste collected from door to door by the municipal trucks is further transferred to transfer station from there it is carried out to HiMSW Jawahar nagar dump yard tippers. The waste which is collected is a non-hazardous waste.

The waste which is dumped in the tipping hall contain organic waste and some metal objects. From the pre-sorting section, the waste which is retained on the 100mm screener is transferred to the tipping hall with the help of trucks in HiMSW. The pre-sorting section waste which is transferred directly to the tipping hall is called RDF Waste.

This RDF waste which is in tipping hall was totally combustible. In tipping hall, it has an openings at the top which is used to transfer the waste to the feeder zone with the help of giant claw crane. By this process incineration of waste is done.

The idea was to ensure scientific disposal of municipal waste, besides generation of power. At Jawahar nagar, through the existing 20 MW power generation plant. For this power generation near 1200 tonnes of solid waste will be utilised daily. With the commissioning of another 28MW power plant at the site, close to 3200 tonnes of sloid waste will be utilised for generation of power every day.

Fig.-10. Waste collecting trucks

Incinerable Waste

The Incinerator quantify and standardize incinerator design parameters. It went out of business over 20 years ago; however, a number of its standards are still in use. One such standard, is used by manufacturers of small and packaged incinerators in rating their equipment. The classifications in the table represent incinerable wastes, wastes which are combustible and are viable candidates for incineration. `

Incinerability can be defined more specifically by consideration of the following factors:

Waste moisture content:

The greater the moisture content, the more fuel is required to destroy the waste. An aqueous waste with a moisture content greater than 95 percent or a sludge waste with less than 15 percent solids content would be considered poor candidates for incineration.

Heating value:

Incineration is a thermal destruction process where the waste is degraded to non-putrescible form by the application and maintenance of a source of heat. With no significant heating value, incineration would not be a practical disposal method. Generally, a waste with a heating value less than 1000 Btu/lb as received, such as concrete blocks or stone, is not applicable for incineration. There are instances, however, where an essentially inert material has a relatively small content (or coating) of combustibles and incineration would be a viable option even with a small heating value. Two such cases are incineration of empty drums with a residual coating of organic material on their inner surfaces and incineration of grit from wastewater treatment plants. The grit adsorbs grease from within the wastewater flow which results in a slight heating value to the grit material, normally less than 500 Btu/lb.

Inorganic salts:

Wastes rich in inorganic, alkaline salts are troublesome to dispose of in a conventional incineration system. A significant fraction of the salt can become airborne. It will collect on furnace surfaces, creating a slag, or cake, which severely reduces the ability of an incinerator to function properly.

High sulphur or halogen content:

The presence of chlorides or sulphides in a waste will normally result in the generation of acid-forming compounds in the off gas. The cost of protecting equipment from acid attack must be balanced against the cost of alternative disposal methods for the waste in question.

Radioactive waste:

Incinerators have been developed specifically for the destruction of radioactive waste materials. Unless designed specifically for radioactive waste disposal, however, an incinerator should not be used for the firing of a radioactive waste.

INCINERATION OF MUNICIPAL SOLID WASTE:

The process of treatment of waste which involves the combustion of substances contained in waste material is called incineration. Industrial plants for waste incineration are commonly referred to as waste to energy facilities. Incineration and other high temperature waste treatment systems are described as ‘’thermal treatment’’. Incineration of waste materials converts the waste into ash, flue gas, and heat. The ash is mostly formed by inorganic constituents of the waste and may take the form of solid lumps or particulates carried by the flue gas. The flue gas must be cleaned of gaseous and particulars carried by the flue gas. The flue gases must be cleaned of gaseous and particulate pollutants before they are dispersed into the atmosphere. In some cases, the heat that is generated by incineration can be used to generate electric power.

In incineration process a large amount of heat can be released by burning municipal waste and that heat can be used to generate electricity power.it has been estimated that waste to energy facilities could supply as much as 2% of electrical power needed in country. And more important is that incineration reduces the volume of waste dramatically, up to 10times. Thus, Incineration can be attractive for large metropolitan area where landfills are a long distance from the population centre.

The major drawback in waste to energy is its combustion facilities at their cost, the level of sophistication needed to operate them safely, and thus the existing despite the assurance of expert that incineration is modern plant with proper air pollution control equipment does not pose any danger to health and environment in Hyderabad. This maintained by with high environment and incineration standards according to CENTRAL POLLUTION CONTROL BOARD and GHMC.

The Incinerators for destruction of solid waste are the most difficult class of incinerators to design and operate, primarily because of the nature of the waste material. Solid waste can vary widely in composition and physical characteristics, making the effects of feed rates and parameters of combustion very difficult to predict. Solid waste incinerators most often burn wastes over a range of low and high heat values.

And while coming to incineration section in HiMSW JAWAHARNAGAR DUMP YARD, in waste to energy plant the whole section has a grate type system. This system can store a mass solid waste for burning in the incinerator. And by using this section it can produce huge amount heat at the feeder zone. In Hyderabad there is a high generation of solid waste.so for the generation of power the grate system is more economical.

Grate system

The grate system is one of the most crucial systems within the mass burning incinerator. The grate must transport RDF through the furnace with the help of giant claw crane and before the crane transport the solid waste it will shaffle the waste by lifting it for some height and release it. This is done 5 to 6time repeatedly before it transfers it into the furnace. This promotes combustion by adequate agitation and good mixing with combustion air. Abrupt tumbling caused by the dropping of burning solid waste from one tier to another will promote combustion. This action, however, may contribute to excessive carryover of particulate matter in the exiting flue gas. A gentle agitation will decrease particulate emissions.

Combustion is largely achieved by injection of combustion air below the grates (i.e., under fire air). Under fire air is also necessary to cool the grates. It is normally provided at a rate of approximately 40 to 60 percent of the total air entering the furnace. Too low a flow of under fire air will inhibit the burning process and will result in high grate temperatures.

These temperatures limit the operating temperatures of the grate areas. With insufficient air a reducing atmosphere will result, and the ash deformation temperature can be as low as 1800°F. If the refuse reaches this temperature, slagging will begin, further reducing the air supply by clogging the grates and forming large, unwieldy clinkers. The ash properties of coal are listed for comparison.

Overfire air is injected above the grates. Its main purpose is to provide sufficient air to completely combust the flue gas and flue gas particulate rising from the grates. Numerous injection points are located on the furnace walls above the grates to provide a turbulent overfire air supply along the furnace length.

Ash and other particles dropping through the grates are termed siftings, and they must be effectively removed from the system. Siftings can readily clog grate mechanisms, generate fires, and create housekeeping problems if not attended to. Siftings, due to their small particle size, have been found to be more-dense than incinerator ash, approximately 1780 versus 1040 lb/yd3 for typical incinerator ash.

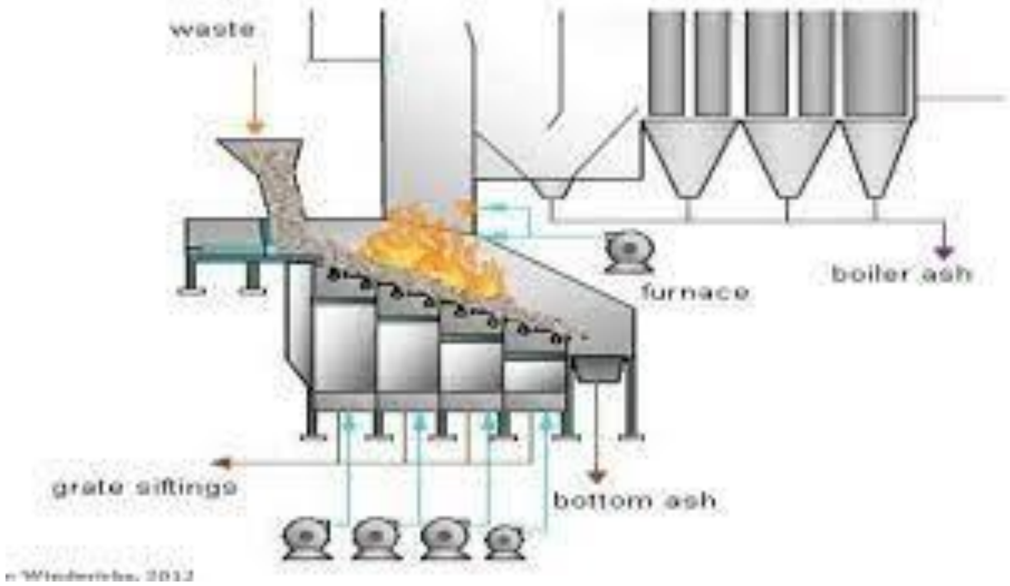


Fig.-11 Incineration process / Grating Process

Grate Design:

A number of different types of grate designs are used in central waste burning facilities. Each grate system manufacturer provides a unique grate feature, attempting to obtain a competitive edge in the marketplace. The grate system manufacturer should be contacted for design and sizing information for a particular grate design. The following listing describes typical grate systems, both generic grate types and grates specific to certain manufacturers.

1. **Traveling Grate:** This type is no longer in common usage. As shown in Fig. below it is normally not a single grate but a series of grates which are placed in a manner that separates the drying and burning functions of the incinerator.

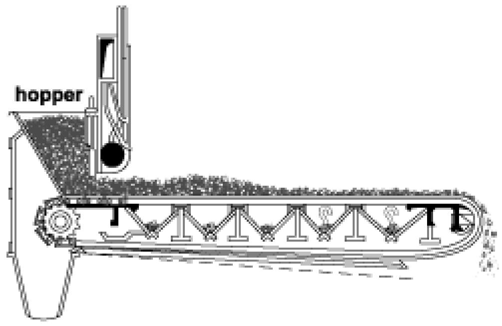


Fig.-12 A Traveling grate platform

2. **Rocking Grate:** As shown in Fig. below, these grate sections are placed across the width of the furnace. Alternate rows are mechanically pivoted or rocked to produce an upward and forward motion, advancing and agitating the waste. The stroke of the grate sections is 5 to 6 in. This grate will handle refuse on a continuous basis.

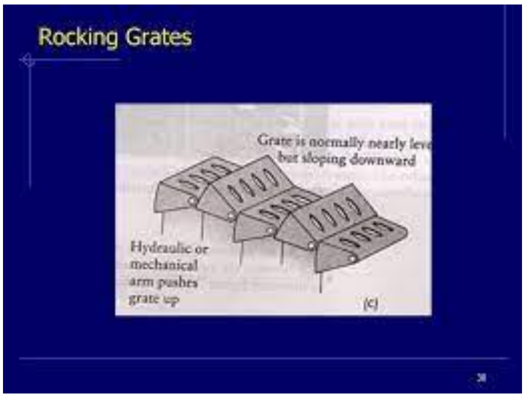


Fig.-13 A Rocking grate platform

3. **Reciprocating Grate:** As shown in Fig. below, this grate consists of sections stacked above each other similar to overlapping roof shingles. Alternate grate sections slide back and forth while adjacent sections remain fixed. Drying and burning are accomplished on single, short but wide grates. The moving grates are basically bars, stoking bars, which move the waste along and help agitate it.

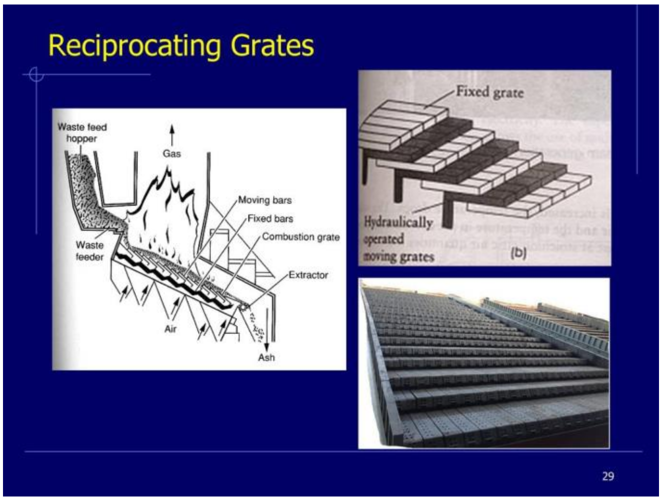


Fig.-14 A Reciprocating grate platform

Process of generation of power:

- When the solid waste is feeded to the boiler, the numerous ignition injector points are located on the furnace walls above the grates to provide a turbulent overfire air supply along the furnace length.
- The ignitors go on supply the overfire to the solid waste, till the wase catches the fire.
- The waste is burned at high temperature of 850°c-1000°c in the boilers of incinerators
- The steam is generated due to the heat produced by the burning of solid.
- And this steam is collected and supplied to turbine which is converted to super steam.
- This super steam is supplied to generator turbine, with the help of this super steam the shaft starts running.
- When the shaft starts rotating the mechanical energy is converted to electrical energy.
- And this energy is transferred to the sub-station.
- And the final by product is of two types of ashes i.e. fly ash and bottom ash.
- These ashes are collected from the silos. The fly-ash is used in cement company for the production of cement. And bottom ash is used for landfills.

CHAPTER -4

LANDFILLING

LANDFILL

The landfill is used to describe a unit operation for final disposal of Municipal solid waste on land and is systematic disposal technique especially for the rejected waste after processing. The term encompasses other terms such as secured landfill and engineered landfills which are also sometimes applied to municipal solid waste (MSW) disposal units. Development and operation of sanitary landfill (SLF) is an integral part of MSW processing. The remnants from processing and unstable waste have to be disposed off in SLF on daily basis. Landfill is vital component of any well designed SWM system. It is the ultimate repository of all other SMW options.

Collection of landfill material is done by various processes they are pre-sorting, leachate treatment and incineration in pre-sorting unit the municipal waste which is rejected from the screen of 100mm, 20mm and 4mm is taken as land fill material, where in leachate treatment plant, the leachate which is obtained from sanitary landfill is conveyed through drain into leachate ponds this will be treated in treatment plant and the obtained bio product is sludge which is bio-degradable and used as landfill material, where in incineration the burned RDF is form into fly ash this is used as landfill material and cement manufacturing industries.

Fig.-15 Land Filling by JCB's at Jawahar Nagar DU

LANDFILL DESIGN CRITERIA:

Design considerations for sanitary landfill development are primarily guided by the characteristics of the proposed site and the guidelines framed by the ministry of environment and forests, Govt of India. Part II, section 3, sub-section (ii), Rule 6(**1**),6(3), and 7(2) of the guidelines indicate that the sanitary landfill shall comply with the following conditions:

- The minimum bottom liner specification shall be a composite barrier having 1.5mm high density polyethylene (HDPE) geo membrane overlying 900mmof soil (clay/amended soil) having permeability coefficient not greater then 1x10^{-7}cm/sec. the surface below amended soil layer should be well compacted.

- Waste shall be compacted adequately provided with daily cover of minimum 10cmof soil inert debris.
- Prior to commencement of monsoon, intermediate cover of thickness of about 45cm has to be provided with proper compaction and grading to prevent infiltration during Monsoon proper drainage bream shall be provided to divert runoff from the active cell of the land fill
- The final cover shall have a barrier layer comprising of 60cmof clay/amended soil with permeability coefficient not greater than 1x10^{-7}cm/sec., on the top of the barrier soil layer there shall be composite barrier having 1.5mm high density polyethylene (HDPE) sheet. Over that shall be a drainage layer of 15cmand one the top of drainage layer there shall be a vegetative layer of 45 cm thick.
- The post closure care of land fill site shall be conducted for at least 15 years and long term monitoring plant shall be prepared.
- In order to prevent pollution problems storm water diversion drains, leachate collect and treatment system and preventive measures for runoff from land fill area entering any stream, lake, river or pond shall be provided.
- Buffer zone around the landfill site and a vegetative cover the completed sit shall be provided.
- Leachate monitoring well has to be provided.

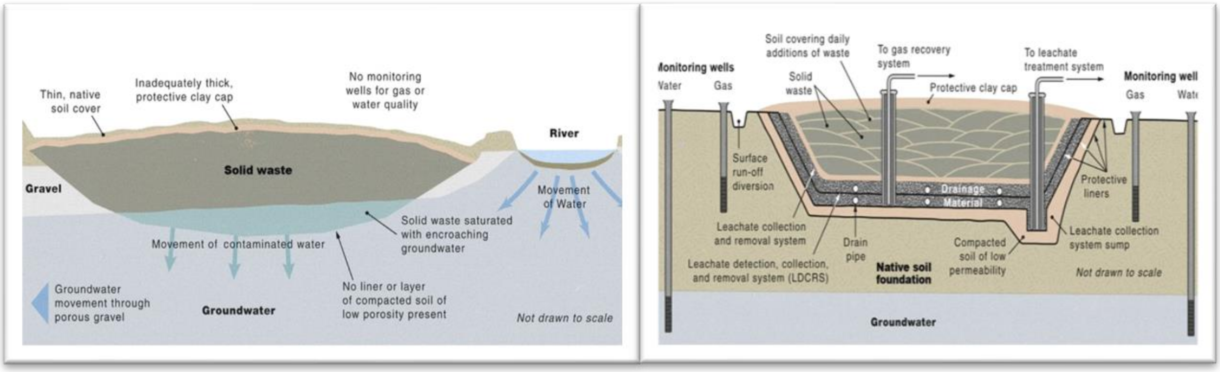


Fig.-16 Before and After designing of land filling

PREPARATION OF LINER SYSTEM:

- Liner system with in a land fill involves prevention of percolation of leachate from waste in landfill to the sub-soil by a suitable protective system (liner system), which comprises of a combination of barrier material such as natural clay and amended soil and a flexible geo-membrane. The liner system will be of low permeability and will be robust, durable and to resist the chemical attack, puncture, rupture etc.

- The liner system is designed in compliance with Municipal Solid Waste (Management and Handling) Rules 2000 and, will comprise, a 90cm thick compacted clay or amended soil of permeability not greater than $1x10^{-7}$, a HDPE geo-membrane liner of thickness 1.5mm and a drainage layer of 15cm thick granular material of permeability not greater than $1x10^{-2}$ cm/sec
- Preparation of Amended Soil Liner. The permeability of local soil varies depending upon the soil condition. To reduce the permeability to $1x10^{-7}$, the soil will be amended with bentonite, which is known to have permeability of the order 1×10^{-7} cm/sec.
- Based on the soil characteristics, it is recommended to maintain the soil and bentonite proportion as 80:20 and mix the additives on site, before it is placed at the base of the landfill site, as a barrier layer
- After the preparation of the amended soil liner, the liner should be constructed in series of lifts each of 25cm compacted to about 15cm by four to five passes of sheep foot roller. The finished thickness of the liner should be 90 cm and the final permeability of the amended soil should also be checked for the desired permeability of 1×10^{-7}.

Fig.-17 Clay Liner's system with perforated pipes in the landfill

GEO-MEMBRANE LINER: Geo-membrane is relatively a thin sheet of flexible thermoplastic or thermopolymeric material. Because of their inherent impermeability, geo-membranes are proposed as barrier layer in landfill site. Even though geo-membranes are highly impermeable, their safety against manufacturing, installation, handling and other defects is essential criteriain design of liner system. The effectiveness of barrier layers basically depends on the hydraulic conductivity of the day/amended clay liner and density of geo membrane. The clay liner is effective only if it is compacted properly and geo membrane liner is effective only if it has a density or mass per unit area is sufficient enough against puncture.

- In order to strengthen the base to avoid any seepage of generated leachate, a layer of 1.5 mm thickness Geo membrane (HDPE liner) is laid over the clay liner. This liner is laid with the helpof double wedge hot shoe welder to prevent leakage and testing is done for the same. The linershall be anchored at the top of landfill side wall and side cutting beyond the stipulated area of the fill.
- Granular Soil Material with 6 mm stone aggregate. At the bottom of the liner, coarse sandwould be spread. The thickness of the sand would be 300mm thick.

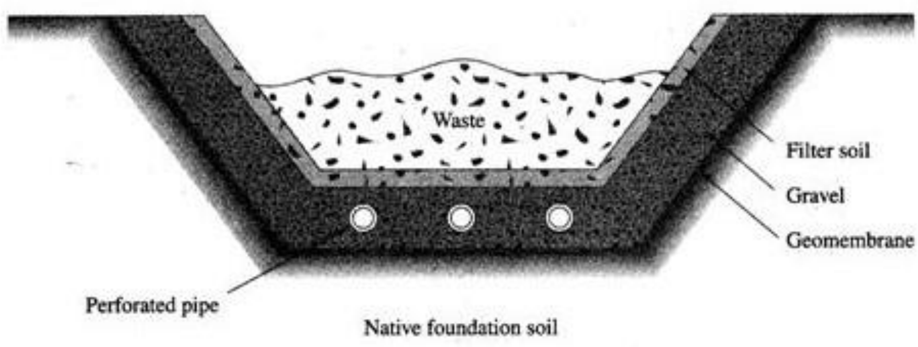


Fig.-18 Geo-membrane Liner's system with perforated pipes in the landfill

SETTLING PROCESS IN A LANDFILL

- **Primary consolidation**: During this stage, a substantial amount of settling occurs. This settlement is caused by the weight of the waste layers. (Fig. 5) The movement of trucks, bulldozers or mechanical compactors will also enhance this process. After this primary consolidation, or short-term deformation stage, aerobic degradation processes occur.
- **Secondary compression**: During this stage, the rate of settling is much lower than that in the primary consolidation stage, as the settling occurs through compression, which cannot be enhanced.

- **Decomposition:** During the degradation processes, organic material is converted into gas and leachate. The settling rate during this stage increases compared to the secondary compression stage and continues until all decomposable organic matter is degraded.

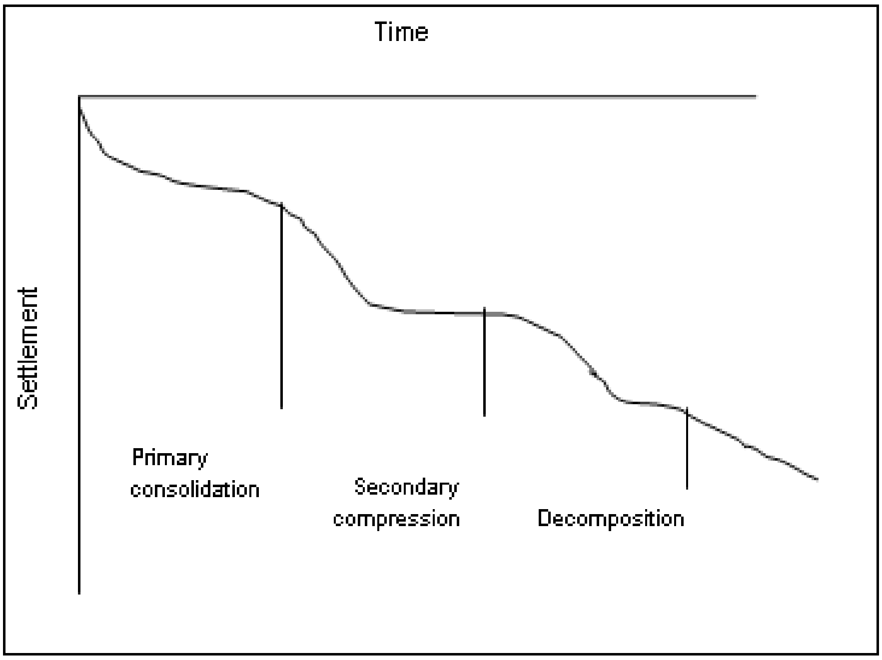


Fig.-19 Settling process in a landfill

The microbial degradation process is the most important biological process occurring in a landfill. These processes induce changes in the chemical and physical environment within the waste body, which determines the quality of leachate and both the quality and quantity of landfill gas. Since, landfills mostly receive organic wastes microbial processes will dominate the stabilization of the waste and therefore govern landfill gas generation and leachate composition.

Soon after disposal, the predominant part of the wastes becomes anaerobic, and the bacteria will start degrading the solid organic carbon, eventually to produce carbon dioxide and methane. The biotic factors that affect methane formation in the landfill are pH, alkalinity, nutrients, temperature, oxygen and moisture content.

(i) Leachate Formation

Leachate can pollute both groundwater and surface water. The degree of pollution will depend on local geology and hydrogeology, nature of waste and the proximity of susceptible receptors. The amount of leachate generated depends on:

- Water availability
- Landfill surface condition
- Refuse state
- Condition of surrounding strata

The major factor, i.e., water availability, is affected by precipitation, surface runoff, waste decomposition and liquid waste disposal. The water balance equation for landfill requires negative or zero ("Lo") so that no excess leachate is produced. This is calculated using the following formula.

$Lo = I - E - aW$

i.e. $I - E < aW$

Where Lo = free leachate retained at site (equivalent to leachate production minus leachate leaving the site); I = total liquid input; E = evapotranspiration losses; a = absorption capacity of waste; and W = weight of waste disposed.

Common toxic components in leachate are ammonia and heavy metals, which can be hazardous even at low levels, if they accumulate in the food chain. The presence of ammoniacal nitrogen means that leachate often has to be treated off-site before being discharged to a sewer, since there is no natural bio-chemical path for its removal. The degree of groundwater contamination is affected by physical, chemical and biological factors. The best way to control leachate is through prevention, which should be integral to the site design. In most case, it is necessary to control liquid access, collection and treatment, all of which can be done using the following landfill liners.

(ii) Leachate Treatment

Concentrations of various substances occurring in leachate are too high to be discharged to surface water or into a sewer system. These concentrations, therefore, have to be reduced by removal, treatment or both. The various treatments of leachate include:

Leachate recirculation: It is one of the simplest forms of treatment. Recirculation of leachate reduces the hazardous nature of leachate and helps wet the waste, increasing its potential for biological degradation.

Biological treatment: This removes BOD, ammonia and suspended solids. Leachate from land fill waste can be readily degraded by biological means, due to high content of volatile fatty acids (VFAs). The common methods are aerated lagoons (i.e., special devices which enhance the aerobic processes of degradation of organic substances over the entire depth of the tank) and activated sludge process, which differs from aerated lagoons in that, discharged sludge is re-circulated and often leads to BOD and ammonia removal. While under conditions of low COD, rotating biological contractors (i.e., biomass is brought into contact with circular blades fixed to a common axle which is rotated) are very effective in removing ammonia. In an aerobic treatment system, complex organic molecules are fermented in filter. The common types are anaerobic filters, anaerobic lagoon and digesters.

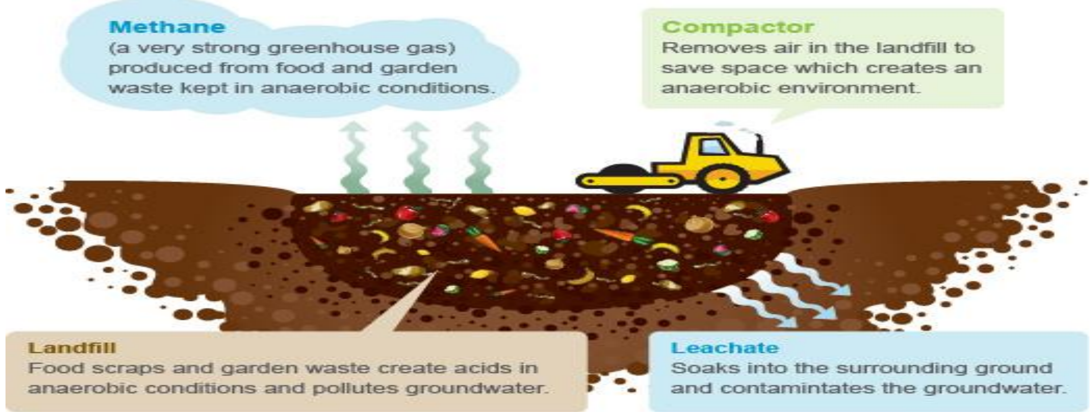


Fig.-21 Biological Treatment of organic waste

Physiochemical treatment: After biological degradation, effluents still contain significant concentrations of different substances. Physiochemical treatment processes could be installed to improve the leachate effluent quality. Some of these processes are flocculation and precipitation. Separation of the floc from water takes place by sedimentation, adsorption and reverse osmosis.

Leachate and Landfill Gas

Leachate may contaminate the surrounding land and water; landfill gas can be toxic and lead to global warming and explosion leading to human catastrophe. The major factors, which affect the production of leachate and landfill gas are nature of waste, moisture content, pH, particle size and density, temperature etc.

Landfill gas contains a high percentage of methane due to the anaerobic decomposition of organic matter, which can be utilized as a source of energy. A typical landfill gas contains a number of components other than Methane such as Carbon dioxide, Oxygen and Nitrogen.

The basic elements of the leachate collection system (i.e., drain pipes, drainage layers, collections pipes, sumps etc) must be installed immediately above the liner, before any waste is deposited. Particular care must also be taken to prevent the drain and collection pipes from settling. During landfill operations, waste cells are covered with soil to avoid additional contact between waste and the environment. The soil layers have to be sufficiently permeable to allow downward leachate transport. Landfill gas is not extracted before completion, which includes construction of final cover of the waste body. Extraction wells (diameter 0.3 to 1.0m) may be constructed during or after operation.

Leachate landfill:

- Liquid that, In the course of passing through matter, extracts soluble or suspended solids, or any other component of the material through which it has passed known as leachate.
- It is mixture of organic degradation products, liquid waste and rain water.
- It has high organic carbon content, high concentrations of nitrogen and is usually slightly acidic.

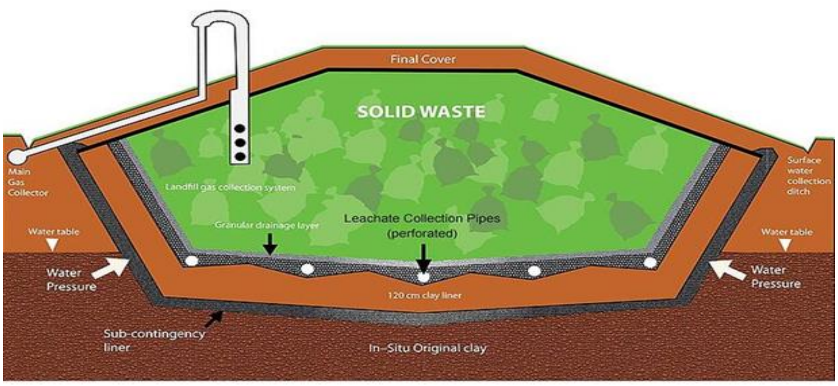


Fig.-22 collection of leachate at lanfill

CHAPTER -5

LEACHATE TREATMENT

LEACHATE:

Leachate is a liquid that forms when landfill waste breaks down through biodegradation process and rain water enters into waste. A leachate is any liquid that, in the course of passing through matter, extracts soluble or suspended solids, or any other component of the materials through which it has passed. Leachate is a widely used term in the environmental sciences where it has the specific meaning of a liquid that has dissolved or entrained environmentally harmful substances that may then enter the environment. It is most commonly used in the context of land-filling of putrescible or industrial waste.

Fig.-23 leachate flow in landfill

Mostly leachate is generated during composting as the biodegradable matter is fermented. It is a thick liquid with strong odor with very high biochemical oxygen demand (BOD) and chemical oxygen demand (COD). However, it has moisture and nutrients, which can be put to good use. Leachate can be treated biologically. Control of leachate is a very important part of operating a compost plant safely.

Leachate is generated from household waste is a concentrated liquid resulting from the decomposition of organic matter. The leachate is collected in a series of pump station around the site and transferred into leachate holding tanks. It contains several chemical elements that cause an unlimited risk to the environment, such as groundwater pollution and air pollution which ultimately leads to a negative impact on humans. The leachate treatment plant is a significant facility established by HiMSW with in its endeavour's to protect human health monitor engineered landfills and conserve the environment almost around the city.

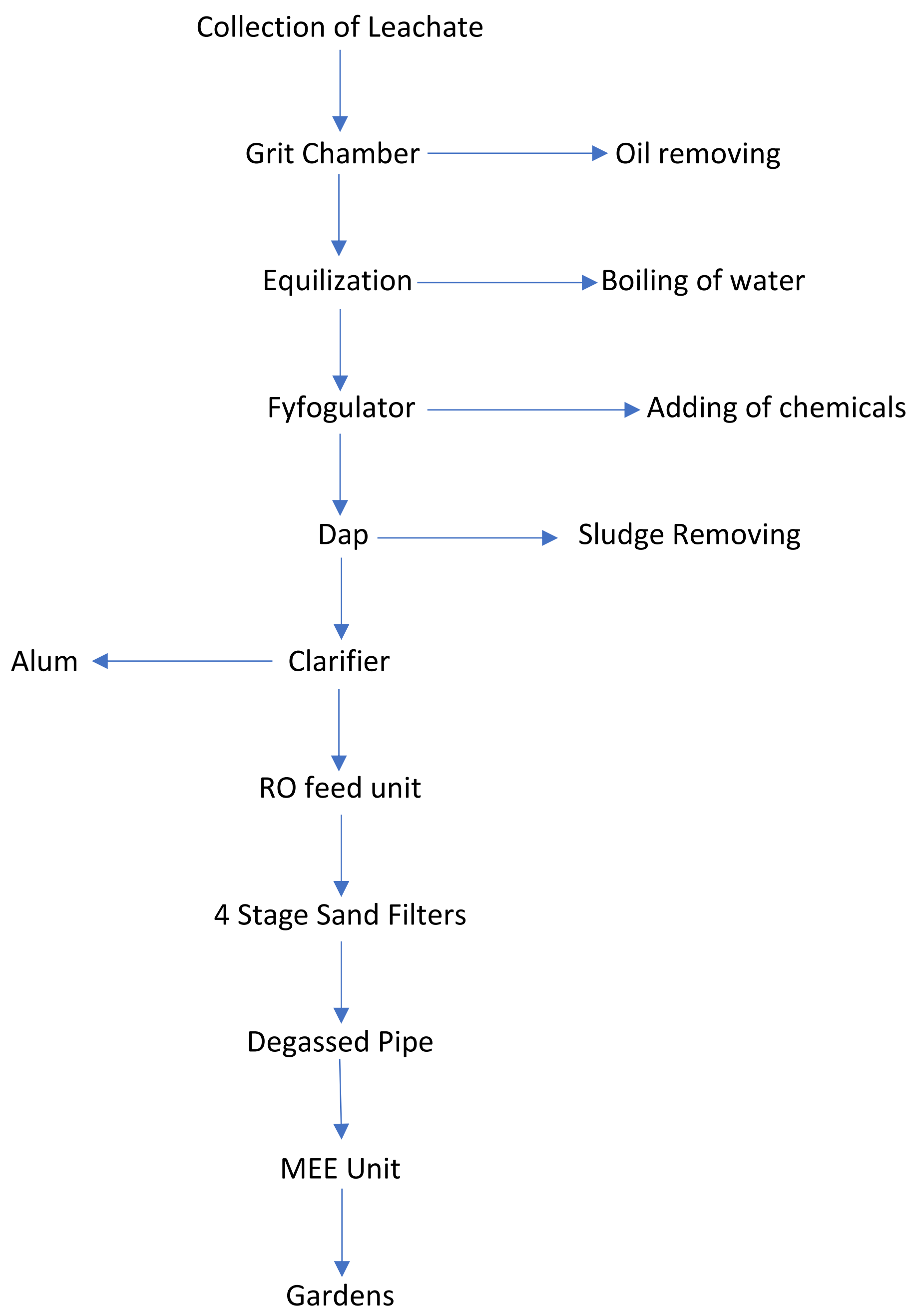
COLLECTION OF LEACHATE:

A leachate collection system basically consists of a drainage layer of inert material with high permeability, of drainage pipes which have to collect the leachate and discharge it out of the dumping area, of collection and inspection shafts, and of collection pipes.

Leachate is collecting from the windrow operations, landfill, and RDF through the drains to the leachate collecting tank. In windrow operations the leachate is generated from the heaps (due to rain water and the decomposition of organic waste leads to generate the leachate) is collected through the drain pipes. The rejected material from the monsoon section and fine refinement section is used as a landfill material after the construction the thicky water is generated in the land is considered as a leachate is collected through the pipes to the pond. RDF material is stored as a 3-zone in tipping hall, which is a stacking zone and the leachate is generated and it is conveyed through drains in to the collecting pond. Leachate consists of a lot of components in them, like you can find soluble components of the waste, you can also find alot of suspended solids and other degraded products.

The characteristics of the leachate will always depend on the composition of waste where presence of biodegradable substances in them like moisture content, weather conditions, waste holding time and other operational procedures. If landfill is not properly managed then this leachate can seep into the ground water and it will contaminate entire aquifer.

FLOWCHART OF LEACHATE TREATMENT:



TREATMENT OF LEACHATE:

In leachate treatment, the leachate is treated in a 3-stages to get a clear water which is only used for gardening and vehicle cleaning.

The 3 stages of leachate treatment are:

1. Preliminary treatment
2. RO treatment
3. MEE-ATFD

PRE-TREATMENT UNIT:

- In this stage the leachate is collected from the leachate collecting pond through pipes to the grit chamber.
- In grit chamber, the leachate is allowed to remove the oil contaminants by using screeners and suspended particle of size 1mm-20mm are deposited down.
- After removing the oil from leachate, now the leachate is passed to the equilization chamber. Were the thicky water is allowed to be stable for few hours to exposed to the atmosphere to remove the bad smell.
- The leachate is collected from the leachate collected tank through the drains to the pre-treating unit of grit chamber.
- In grit chamber, the leachate is allow to be undisturbed for removal of oil from the waste water.
- After the removing of oil from the leachate, then it is transferred into the equilization chamber.
- In this equilization chamber, the leachate is exposed to the aeration process to expose to oxygen to remove the odour from the leachate.
- After this process, it is passed to the fyfogulator section, in this section some amount of chemicals is added to the leachate to make the all-suspended particles to settle down at the bottom of the sedimentation tank.
- After the settling of sludge at the bottom in a tank with the help of cleaner the removal of sludge will takes place in a DAP chamber.
- The chemicals which are added to the leachate to remove sludge is PC(1500), PC(1000), AND PE chemicals which makes sludge to settle down.
- If the amount of PE is added to leachate is more, then the sludge will not settle down, it will float at the top of the tank.
- Around 1100kiloliters leachate of treated per and this chamber is designed with a depth of 1meter and 5mts X 5mts length & width.
- From the DAP, the waste water is moved to the clarifiers, in this clarifier, the leachate is treated in a 3-stages by adding a dosaging of alum and lime with pc(1000) , pc(500)& pe.
- For every 5KN of clarifier tank, the dosing of chemicals is every important to clear the all particles in it.

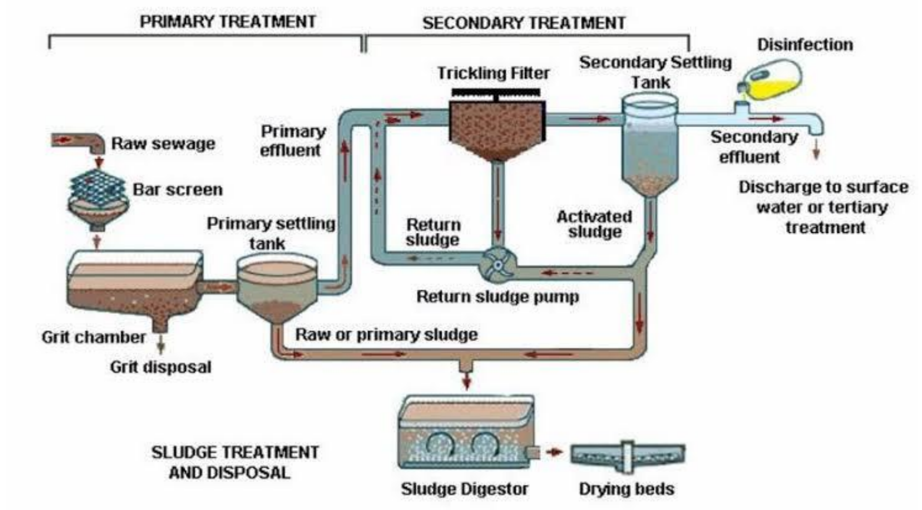


Fig.-24 preliminary treatment of Leachate

RO-TREATMENT UNIT:

- After the pre-treatment, the leachate is moved to the RO unit which is under the reverse osmosis process.
- The leachate is entered to the 4-stage sand filter to allow the fine particles to settle down at the bottom.
- After removing the fine suspended particles from leachate, it is passed to the RO first stage module by using high pressure pumps with 60 N/m^2.
- In RO first stage the water is passed to the fine filters which having a size 300microns membrane.
- In this partial filterization will takes ad the leachate will allow to through pass to the second stage of RO filter.
- In this the complete colour change of leachate will observe by filterazation process.
- In RO first stage, 50% of the leachate is filtered, after this in RO second stage upto70% the water is filter.
- If any other impurities are present in it, is going to be removed in the intermediate tank.
- The filtered leachate is moved to the intermediate tank, in this again the leachate water is filtered to remove the excess waste which is present in it to make the water clean.
- Now the clear water is allowed to store in tank and degassed pipe is attached to extract gasses which is evaluating from the RO unit.
- The filtered water is now passed to the MEE unit.

Fig.-25 Reverse osmosis filters process

MEE-ATFD (MULTI EFFECTIVE EVAPOURATOR-ASSISATIVE THEIR FILM DRAGER):

- In this MEE-ATFD unit, the chemicals which are not removed in RO unit are removed in this unit by steaming.
- The clear water/filtered water is now allowed to the steams to generate steam by boiling filtered water.
- The steam is collected as a purified water and it is used for gardening purpose and also used for vehicle cleaning, but it is not suggestable for domestic needs.
- After the boiling the remaining excess material, and the settlement of salt is taken placed at the bottom of the boiler.
- In MEE-AFTD unit the leachate is treated upto 90% which is only used for only watering in garden and farming.

Fig.-26 MEE-AFTD steamers

ADVANTAGES OF LEACHATE TREATMENT:

1. Lower disposal of phosphorous required as a growth factor for anaerobic bacteria.
2. Lower excess sludge production.
3. Lower energy usage and operation costs.
4. Useable biogas production.
5. Removal of more than 90% of BOD.
6. HIGHER organic loading rates.

DISADVANTAGES OF LEACHATE TREATMENT:

1. Heavy metals can prevent digestion.
2. Ammonia toxicity
3. Sensitive to change temperature and pH, as well as varies toxic substances exiting in influent of the reactor or by products produced in the reactor.
4. Remain high concentration of ammonia in effluent.
5. Long time for start-up.

CHAPTER -6

RECYCLING OF PLASTIC

Plastic recycling:-

Plastic recycling is the method of gathering waste plastic and reconverting them to new and useful plastic products. The world produces and makes use of more than a trillion pounds of plastic material. Plastic recycling ensures that is massive amount of plastic does not go to waste.

The main aim of recycling: -

Recycling reduces the need for extracting, refining processing raw materials all of which. Create air and water pollution. as recycling. Saves it energy it also reduces greenhouse gas emissions, which create air and water pollution. As recycling greenhouse gas an emission, which helps to Tackle climate change. Recycling prevents the emissions of many greenhouse gases and water pollutants, and saves energy. Using recovered material generates less solid waste. Recycling helps to reduce the pollution caused by the extraction and processing of virgin materials.

Importance of plastic recycling: -

For every ton of plastic that is recycled, 7.4 cubic yards of land fill spaced is saved. Ensuring we recycling as much plastic as possible will extend the lives our landfill sights, and stop the process many practices of burning plastics to save space, which releases toxic irritants and pollutants into the atmosphere.

Fig.-31 Granules of plastic

Purpose of recycling: -

Recycling conserves resources: If used material are not recycled, new products are made by extracting fresh, raw material from the earth, through mining and forestry. Recycling helps conserve important raw materials and protects natural habitats for the future.

Process of recycling:-

Recycling, recovery and reprocessing of waste materials for use in new products. The basic phases in recycling are the collection of waste materials, their processing or manufacture into new products, and the purchase of those products, which may then themselves be recycled.

The plastic recycling process steps:-

1) Collection and wishing
2) Sorting +categorizing
3) Washing Shredding
4) Identification and separation of plastics
5) Extruding + compounding

1. Collection + distribution: -

The first step in the mechanical recycling process is the collection of post – consumer materials from homes, businesses, and institutions. This can be done by either local government or private companies, with the latter often a popular option for businesses. Another option is taking plastics to communal collection points such as designated recycling bins or facilities. This may be as simple as a bottle bank on a street corner or as complex as a local waste sight with large areas various recyclable and non-recyclable municipal solid waste (MSW).

Fig.-27 collected plastic

2. Sorting & categorizing: -

The next step in the plastic recycling process is sorting. There are several different types of plastic (see below), which need to be separated from each other by recyclers. further to that, plastic might be sorted. By another properties such as color, thickness and use. This an important step to increase the efficiency of plants. And avoid the contamination of end products.

Fig.-28 Separation by category

3. washing: -

washing is a crucial step in the plastic recycling process since it removes same of the impurities that can impede the operation, or completely ruin a batch of recycled of plastic. The impurities targeted in this step commonly include things such as products such as labels and adhesives as well as dirt and food residue. While plastic is often washed at this stage, it is important to remember that this does not take disposal and collection.

Fig.-29 Cleaning of plastic materials

4. **<u>Shredding</u>: -**

The plastic is then fed into shredders, which break it down into much smaller pieces. These smaller pieces, unlike formed plastic products, can be processed in the next stages for reuse. Additionally, the resized plastic pieces can be used for other applications without further processing, such as an additive within asphalt or simply sold as a raw material.

Breaking down the plastic into smaller pieces also allows for any remaining impurities to be found. This is especially true of contaminants. Such as metal, this may not have been removed by washing but can be easily collected with a magnet at this stage.

Fig.-30 plastic shedder by using shedder machine

5. **<u>Identification and separation of plastics</u>: -**

Here, the plastic pieces are tested for their class and quality. First is segregate based on density, which is tested by floating particles of plastic in a container of water? This is followed by a tested for what is known as the "air classification", which determines the thickness of the plastic pieces it is done by placing the shredded plastic into wind tunnel, with thinner pieces floating while larger /thicker pieces stay at the bottom.

6. **<u>Extruding +compounding</u>: -**

This final plastic recycling process step is where the particles of shredded plastic are transformed into a usable product for manufactures. The shredded plastic is melted and crushed together to form pellets it is worth nothing that it is not always possible to compound all types, classifications and qualities of plastic at a single plant so different grades of plastic are sometimes sent to other recycling facility for this final step.

<u>Advantages of recycling</u>: -

1. Conserving natural resources
2. Protecting eco systems and wild life
3. Reducing demand for raw materials
4. Saving energy
5. Cutting climate changing carbon emissions
6. Cheaper than waste collection and disposal
7. Talkies youth unemployment

<u>Disadvantages of recycling</u>: -

- More pollution and energy consumption
- Result in pollutants
- Increased processing cost and low-quality job.
- Require stricter and more stringent implementation.
- Good products are not guaranteed.
- Generally effective.

CONCLUSION

- The solid waste has high plastic content, metals and alloys. Our aim is to make this plastic as recyclable and reuse the material to reduce the plastic pollution.
- To dump the solid waste, it took acres of land, by increasing of population generating waste is more to reduce the dumping land reusing of waste methods are important.
- Higher quantity of flammable gas ids generated from the landfills which is used as fuel to make light and heat.
- Using this solid waste generation of electricity is useful to increase the power supply for consumers.
- Leachate is very harmful liquid is having a pH range of 8-8.5.
- The treated leachate water can be utilized for purpose like gardening, washing vehicles and cleaning sheds etc.
- Compost is a manure which is a very natural fertilizer, which helps the fields to grow with little amount of chemicals.
- The flammable gas which is generated is considered as bio gas which is supplied in future to home through a pipe line.

LITERAURE VIEW:

The study of municipal solid waste management is to get ana analysis on waste material across the city. And to analyse the new idea to control the municipal which is a main concern to government of Hyderabad city. It also helps in understanding the people who controls the waste and how to make the surroundings clean to reduce health diseases.

LITERATURE REVIEW:

- **George Tchbanoglous And Frank Kreith:**

  These two authors are interest in the areas of solid waste management, waste water treatment, waste water filtration, aquatic systems for waste water treatment and individual onsite treatment systems.

- **Swachh Bharath Mission (Municipal Solid Waste Management Manual Part-2)-2016**

  This manual on municipal solid waste management provides guidance to urban local bodies on planning ideas design, implementation and monitoring of municipal solid waste management systems.

  The manual clearly defines the planning process to be adopted by urban local bodies for preparing, revising and implementing municipal solid waste management plan (MSWM Plans)

REFERENCE

- Waste Water Engineering by Metcalf & Eddy, Fourth Edition.
- Water Supply and Environmental Engineering by R. C. Punia.
- Some topics are gathered from Internet.

PERSONAL VISIT:

- Hyderabad Municipal Water sanitary and Sewage Board